

WHAT IS CLAIMED IS:

- 1                   1. A method of equalizing a signal, wherein the  
2 signal comprises a series of input blocks of coded data, the  
3 method comprising at least the following steps:
  - 4                   a) shifting data in each input block of data to  
5 the left;
  - 6                   b) complex multiplying each of the left shifted  
input block of data by a first set of equalizer coefficients  
to provide respective first adjusted output blocks of data,  
wherein step b) is not a full solution to ghosts;
  - 7                   c) complex multiplying each of the input blocks of  
data by a second set of equalizer coefficients to provide  
respective second adjusted output blocks of data, wherein  
step c) is not a full solution to ghosts;
  - 8                   d) shifting the data in each input block of data  
to the right;
  - 9                   e) complex multiplying each of the right shifted  
input block of data by a third set of equalizer coefficients  
to provide respective third adjusted output blocks of data,  
wherein step e) is not a full solution to ghosts;

20 f) adding corresponding ones of the first, second,  
21 and third adjusted output blocks of data; and,  
22 g) controlling the first, second, and third sets  
23 of equalizer coefficients so that, as a result of the  
24 addition performed according to step f), a substantially  
25 full solution to ghosts is obtained.

2. The method of claim 1 wherein step g) comprises the following steps:

estimating the channel; and,  
controlling the first, second, and third sets of  
equalizer coefficients based upon the estimated channel.

3. The method of claim 1 wherein step g) comprises the step of controlling the first, second, and third sets of equalizer coefficients based upon the addition of step f).

4. The method of claim 1 wherein step g) comprises the following steps:

g1) performing a comparison based upon the addition of step f) and the input blocks of data; and,

5 g2) controlling the first, second, and third sets  
6 of equalizer coefficients based upon the comparison  
7 performed in step g1).

g1) comparing results of the addition of step f)  
to a reference to form an error;

g2) conjugating the input blocks of data;

g3) shifting data in the conjugated input blocks of data to the left;

g4) shifting the data in the conjugated input blocks of data to the right;

g5) correlating the left shifted, conjugated input blocks of data and the error;

g6) correlating the conjugated input blocks of data and the error;

g7) correlating the right shifted, conjugated input blocks of data and the error;

q8) controlling the first set of equalizer

coefficients based upon the correlation performed at step q5) :

19                   g9) controlling the second set of equalizer  
20                   coefficients based upon the correlation performed at step  
21                   g6); and,

22                   g10) controlling the third set of equalizer  
23                   coefficients based upon the correlation performed at step  
24                   g7).

1                   6. The method of claim 5 wherein step g5)  
comprises the step of down sampling the left shifted,  
conjugated input blocks of data, wherein step g6) comprises  
the step of down sampling the conjugated input blocks of  
data, and wherein step g7) comprises the step of down  
sampling the right shifted, conjugated input blocks of data.

2                   7. The method of claim 5 wherein the reference is  
a training signal.

1                   8. The method of claim 5 wherein the reference is  
2                   sliced data.

1                   9. The method of claim 1 wherein step g)  
2 comprises the following steps:

3                   g1) comparing results of the addition of step f)  
4 to a reference to form an error;

5                   g2) performing a left shift based upon the input  
6 blocks of data;

7                   g3) performing a right shift based upon the input  
8 blocks of data;

9                   g4) performing a first correlation based upon  
10 results from step g2) and the error;

11                  g5) performing a second correlation based upon the  
12 input blocks of data and the error;

13                  g6) performing a third correlation based upon  
14 results from step g3) and the error;

15                  g7) controlling the first set of equalizer  
16 coefficients based upon the first correlation;

17                  g8) controlling the second set of equalizer  
18 coefficients based upon the second correlation; and,

19                  g9) controlling the third set of equalizer  
20 coefficients based upon the third correlation.

1                   10. The method of claim 11 wherein the reference  
2                   is a training signal.

1                   11. The method of claim 11 wherein the reference  
2                   is sliced data.

1                   12. The method of claim 1 wherein step g)  
2                   comprises the following steps:

                  g1) conjugating the input blocks of data;  
                  g2) shifting data in the conjugated input blocks  
of data to the left;  
                  g3) shifting the data in the conjugated input  
blocks of data to the right;

10                g4) performing a first correlation based upon the  
left shifted, conjugated input blocks of data and the  
addition of step f);

11                g5) performing a second correlation based upon the  
conjugated input blocks of data and the addition of step f);

12                g6) performing a third correlation based upon the  
right shifted, conjugated input blocks of data and the  
addition of step f);

16 g7) controlling the first set of equalizer  
17 coefficients based upon the first correlation;  
18 g8) controlling the second set of equalizer  
19 coefficients based upon the second correlation; and,  
20 g9) controlling the third set of equalizer  
21 coefficients based upon the third correlation.

13. The method of claim 1 wherein step g) comprises the following steps:

g1) performing a left shift based upon the input blocks of data; .

g2) performing a right shift based upon the input blocks of data;

g3) performing a first correlation based upon results from step g1) and the first, second, and third adjusted output blocks of data;

g4) performing a second correlation based upon the input blocks of data and the first, second, and third adjusted output blocks of data;

g5) performing a third correlation based upon results from step g2) and the first, second, and third adjusted output blocks of data;

14. The method of claim 1 further comprising the step of h) applying pre-processing coefficients to each data block prior to steps a), c), and d).

15. The method of claim 14 wherein step g) comprises the step of controlling a width of the pre-processing coefficients so that the width of the pre-processing coefficients is substantially commensurate with a width of a data block and an interval between a data block and a ghost.

1                 16. The method of claim 14 wherein step g)  
2 comprises the following steps:  
3                 estimating the channel; and,  
4                 controlling the first, second, and third sets of  
5 equalizer coefficients based upon the estimated channel.

1                 17. The method of claim 14 wherein step g)  
2 comprises the step of controlling the first, second, and  
3 third sets of equalizer coefficients based upon the addition  
4 of step f).

1                 18. The method of claim 14 wherein step g)  
2 comprises the following steps:  
3                 g1) performing a comparison based upon the  
4 addition of step f) and the input blocks of data; and,  
5                 g2) controlling the first, second; and third sets  
6 of equalizer coefficients based upon the comparison  
7 performed in step g1).

1                   19. The method of claim 14 wherein step g)  
2 comprises the following steps:

3                   g1) comparing results of the addition of step f)  
4 to a reference to form an error;  
5                   g2) conjugating the input blocks of data;  
6                   g3) performing a correlation based upon the error  
7 and the conjugated input blocks of data; and,  
8                   g4) controlling the first, second, and third sets  
of equalizer coefficients based upon the correlation.

1                   20. The method of claim 19 wherein the reference  
2 is a training signal.

1                   21. The method of claim 19 wherein the reference  
2 is sliced data.

1                   22. The method of claim 14 wherein step g)  
2 comprises the following steps:  
3                   g1) comparing results of the addition of step f)  
4 to a reference to form an error;  
5                   g2) conjugating the input blocks of data;



1                   23. The method of claim 22 wherein step g5)  
2 comprises the step of down sampling the left shifted,  
3 conjugated input blocks of data, wherein step g6) comprises  
4 the step of down sampling the conjugated input blocks of  
5 data, and wherein step g7) comprises the step of down  
6 sampling the right shifted, conjugated input blocks of data.

1                   24. The method of claim 22 wherein the reference  
2 is a training signal.

1                   25. The method of claim 22 wherein the reference  
2 is sliced data.

1                   26. The method of claim 14 wherein step g)  
2 comprises the following steps:

3                   g1) comparing results of the addition of step f)  
4 to reference data to form an error;

5                   g2) performing a left shift based upon the input  
6 blocks of data;

7                   g3) performing a right shift based upon the input  
8 blocks of data;

- g4) performing a first correlation based upon results from step g2) and the error;
- g5) performing a second correlation based upon the input blocks of data and the error;
- g6) performing a third correlation based upon results from step g3) and the error;
- g7) controlling the first set of equalizer coefficients based upon the first correlation;
- g8) controlling the second set of equalizer coefficients based upon the second correlation; and,
- g9) controlling the third set of equalizer coefficients based upon the third correlation.

27. The method of claim 26 wherein the reference is a training signal.

28. The method of claim 26 wherein the reference is sliced data.

29. The method of claim 21 wherein step g) comprises the following steps:

- g1) conjugating the input blocks of data;
- g2) shifting data in the conjugated input blocks of data to the left;
- g3) shifting the data in the conjugated input blocks of data to the right;
- g4) performing a first correlation based upon the left shifted, conjugated input blocks of data and the addition of step f);
- g5) performing a second correlation based upon the conjugated input blocks of data and the addition of step f);
- g6) performing a third correlation based upon the right shifted, conjugated input blocks of data and the addition of step f);
- g7) controlling the first set of equalizer coefficients based upon the first correlation;
- g8) controlling the second set of equalizer coefficients based upon the second correlation; and,
- g9) controlling the third set of equalizer coefficients based upon the third correlation.

1                   30. The method of claim 14 wherein step g)  
2 comprises the following steps:

3                   g1) performing a left shift based upon the input  
4 blocks of data;

5                   g2) performing a right shift based upon the input  
6 blocks of data;

7                   g3) performing a first correlation based upon  
8 results from step g1) and the first, second, and third  
9 adjusted output blocks of data;

10                  g4) performing a second correlation based upon the  
11 input blocks of data and the first, second, and third  
12 adjusted output blocks of data;

13                  g5) performing a third correlation based upon  
14 results from step g2) and the first, second, and third  
15 adjusted output blocks of data;

16                  g6) controlling the first set of equalizer  
17 coefficients based upon the first correlation;

18                  g7) controlling the second set of equalizer  
19 coefficients based upon the second correlation; and,

20                  g8) controlling the third set of equalizer  
21 coefficients based upon the third correlation.

1                   31. The method of claim 14 wherein the pre-  
2 processing coefficients are curved.

1                   32. The method of claim 14 wherein the pre-  
2 processing coefficients are curved substantially according  
3 to a function  $1/(2 - \cos(t))$ .

1                   33. The method of claim 1 further comprising the  
2 step of applying a spectral transformation to each data  
3 block prior to steps a), c), and d), wherein the spectral  
4 transformation is longer than a data block.

1                   34. An equalizer for processing blocks of data  
2 comprising:

3                   n - 1 data shifters, wherein each of the n - 1  
4 data shifters shifts the blocks of data;

5                   n finite filters, wherein one of the n finite  
6 filters applies a corresponding set of finite filter  
7 coefficients to the blocks of data, wherein each of the  
8 other n - 1 finite filters applies a set of finite filter  
9 coefficients to a corresponding output of the n - 1 data  
10 shifters, wherein ghosts of the blocks of data are not

11                   eliminated as a result of the application of the sets of  
12                   finite filter coefficients corresponding to the n finite  
13                   filters, and wherein  $n > 2$ ;

14                   an adder arranged to add outputs from the n finite  
15                   filters; and,

16                   a controller arranged to control the sets of  
17                   finite filter coefficients corresponding to the n finite  
18                   filters so that the addition performed by the adder  
19                   substantially eliminates the ghosts.

35. The equalizer of claim 34 wherein the controller comprises a channel estimator that estimates the channel through which the blocks of data are transmitted.

36. The equalizer of claim 34 wherein the controller controls the n sets of finite filter coefficients based upon an output of the adder.

37. The equalizer of claim 34 wherein the controller comprises a comparator that performs a comparison based upon an output of the adder and the blocks of data.

1                   38. The equalizer of claim 34 wherein the  
2 controller comprises:

3                   a comparator arranged to compare an output of the  
4 adder to a reference to form an error;

5                   a conjugator arranged to conjugate the blocks of  
6 data;

7                   n - 1 data shifters arranged to shift the  
8 conjugated blocks of data; and,

9                   n correlators arranged to perform n - 1  
10                  correlations of the shifted, conjugated blocks of data and  
11                  the error and to perform one correlation of the conjugated  
12                  blocks of data and the error, wherein each of the n  
13                  correlators is arranged to control a corresponding set of  
14                  equalizer coefficients.

1                   39. The equalizer of claim 38 wherein the  
2 controller further comprises n down samplers, wherein n - 1  
3 of the n down samplers are arranged to down sample the  
4 shifted, conjugated blocks of data prior upstream of the  
5 correlators, and wherein the other down sampler is arranged  
6 to down sample the conjugated blocks of data upstream of the  
7 correlators.

1                   40. The equalizer of claim 38 wherein the  
2 reference is a training signal.

1                   41. The equalizer of claim 38 wherein the  
2 reference is sliced data.

1                   42. The equalizer of claim 34 wherein the  
2 controller comprises:

                      a comparator arranged to compare an output of the  
                      adder to a reference to form an error;

                      n - 1 data shifters arranged to shift the blocks  
                      of data; and,

                      n correlators arranged to perform n - 1  
                      correlations based upon the shifted blocks of data and the  
                      error and to perform one correlation based upon the blocks  
                      of data and the error, wherein each of the n correlators is  
                      arranged to control a corresponding set of equalizer  
                      coefficients.

1                   43. The equalizer of claim 42 wherein the  
2 reference is a training signal.

1                   44. The equalizer of claim 42 wherein the  
2 reference is sliced data.

1                   45. The equalizer of claim 34 wherein the  
2 controller comprises:

3                   a conjugator arranged to conjugate the blocks of  
4 data;

5                   n - 1 data shifters arranged to shift the  
6 conjugated blocks of data;

7                   n correlators arranged to perform n - 1  
8 correlations based upon the shifted, conjugated blocks of  
9 data and an output of the adder and to perform one  
10 correlation based upon the conjugated blocks of data and the  
11 output of the adder, wherein each of the n correlators is  
12 arranged to control a corresponding set of equalizer  
13 coefficients.

1                   46. The equalizer of claim 34 wherein the  
2 controller comprises:

3                   n - 1 data shifters arranged to shift the blocks  
4 of data; and,

47. The equalizer of claim 34 further comprising a pre-processor that applies pre-processor coefficients to each data block upstream of the  $n - 1$  data shifters and the  $n$  finite filters.

48. The equalizer of claim 47 wherein the controller controls a width of the pre-processing coefficients so that the width is substantially coincident with the width of a data block and an interval between a data block and a ghost.

1 .                   50. The equalizer of claim 47 wherein the pre-  
2 . processing coefficients are curved substantially according  
3 . to a function  $1/(2 - \cos(t))$ .

1                       51. The equalizer of claim 47 wherein the  
2                       controller comprises a channel estimator that estimates the  
3                       channel through which the blocks of data are transmitted.

52. The equalizer of claim 47 wherein the controller controls the n sets of finite filter coefficients based upon an output of the adder.

53. The equalizer of claim 47 wherein the controller comprises a comparator that performs a comparison based upon an output of the adder and the blocks of data.

1                         54. The equalizer of claim 47 wherein the  
2                         controller comprises:  
3                             a comparator arranged to compare an output of the  
4                         adder to a reference to form an error;  
5                             a conjugator arranged to conjugate the blocks of  
6                         data;

7                   n - 1 data shifters arranged to shift the  
8                   conjugated blocks of data; and,

9                   n correlators arranged to perform n - 1  
10                  correlations of the shifted, conjugated blocks of data and  
11                  the error and to perform one correlation of the conjugated  
12                  blocks of data and the error, wherein each of the n  
13                  correlators is arranged to control a corresponding set of  
14                  equalizer coefficients.

55. The equalizer of claim 54 wherein the controller further comprises n down samplers, wherein n - 1 of the n down samplers are arranged to down sample the shifted, conjugated blocks of data prior upstream of the correlators, and wherein the other down sampler is arranged to down sample the conjugated blocks of data upstream of the correlators.

1                   56. The equalizer of claim 54 wherein the reference is a training signal.

1                   57. The equalizer of claim 54 wherein the reference is sliced data.

58. The equalizer of claim 47 wherein the controller comprises:

a comparator arranged to compare an output of the adder to a reference to form an error;

n - 1 data shifters arranged to shift the blocks of data; and,

n correlators arranged to perform  $n - 1$  correlations based upon the shifted blocks of data and the error and to perform one correlation based upon the blocks of data and the error, wherein each of the n correlators is arranged to control a corresponding set of equalizer coefficients.

59. The equalizer of claim 58 wherein the reference is a training signal.

60. The equalizer of claim 58 wherein the reference is sliced data.

1                   61. The equalizer of claim 47 wherein the  
2 controller comprises:

3                   a conjugator arranged to conjugate the blocks of  
4 data;

5                   n - 1 data shifters arranged to shift the  
6 conjugated blocks of data;

7                   n correlators arranged to perform n - 1  
8 correlations based upon the shifted, conjugated blocks of  
9 data and an output of the adder and to perform one  
10 correlation based upon the conjugated blocks of data and the  
11 output of the adder, wherein each of the n correlators is  
12 arranged to control a corresponding set of equalizer  
13 coefficients.

14                   62. The equalizer of claim 47 wherein the  
15 controller comprises:

16                   n - 1 data shifters arranged to shift the blocks  
17 of data; and,

18                   n correlators arranged to perform n - 1  
19 correlations based upon the shifted blocks of data and an  
20 output of the adder and to perform one correlation based  
21 upon the blocks of data and the output of the adder, wherein

9           each of the n correlators is arranged to control a  
10          corresponding set of equalizer coefficients.

1           63. The equalizer of claim 34 wherein  $n > 4$ .

2           64. The equalizer of claim 34 further comprising  
3           a spectral transformation applied to each data block  
4           upstream of the  $n - 1$  data shifters and the n finite  
5           filters, wherein the spectral transformation is longer than  
6           a block of data.

7           65. An equalizer for processing blocks of data  
8           comprising:

9           a first data shifter, wherein the first data  
10          shifter is arranged to shift the data left by two;

5           a second data shifter, wherein the second data  
6           shifter is arranged to shift the data left by one;

7           a third data shifter, wherein the third data  
8           shifter is arranged to shift the data right by one;

9           a fourth data shifter, wherein the fourth data  
10          shifter is arranged to shift the data right by two;

11                   a first finite filter, wherein the first finite  
12 filter applies a first set of finite filter coefficients to  
13 each of the blocks of data which have been shifted by the  
14 first data shifter, wherein ghosts of the blocks of data are  
15 not eliminated as a result of the application of the first  
16 set of finite filter coefficients;

17                   a second finite filter, wherein the second finite  
18 filter applies a second set of finite filter coefficients to  
19 each of the blocks of data which have been shifted by the  
20 second data shifter, wherein ghosts of the blocks of data  
21 are not eliminated as a result of the application of the  
22 second set of finite filter coefficients;

23                   a third finite filter, wherein the third finite  
24 filter applies a third set of finite filter coefficients to  
25 each of the blocks of data, wherein ghosts of the blocks of  
26 data are not eliminated as a result of the application of  
27 the third set of finite filter coefficients;

28                   a fourth finite filter, wherein the fourth finite  
29 filter applies a fourth set of finite filter coefficients to  
30 each of the blocks of data which have been shifted by the  
31 third data shifter, wherein ghosts of the blocks of data are

32 not eliminated as a result of the application of the fourth  
33 set of finite filter coefficients;

34 a fifth finite filter, wherein the fifth finite  
35 filter applies a fifth set of finite filter coefficients to  
36 each of the blocks of data which have been shifted by the  
37 fourth data shifter, wherein ghosts of the blocks of data  
38 are not eliminated as a result of the application of the  
39 fifth set of finite filter coefficients;

40 an adder arranged to add outputs from the first,  
41 second, third, fourth, and fifth finite filters; and,

42 a controller arranged to control the first,  
43 second, third, fourth, and fifth sets of finite filter  
44 coefficients so that the addition performed by the adder  
45 substantially eliminates the ghosts.

1 66. The equalizer of claim 65 wherein the  
2 controller comprises a channel estimator that estimates the  
3 channel through which the blocks of data are transmitted.

1                   67. The equalizer of claim 65 wherein the  
2 controller controls the first, second, third, fourth, and  
3 fifth sets of finite filter coefficients based upon an  
4 output of the adder.

1                   68. The equalizer of claim 65 wherein the  
2 controller comprises a comparator that performs a comparison  
3 based upon an output of the adder and the blocks of data.

69. The equalizer of claim 65 wherein the  
controller comprises:

                  a comparator arranged to compare an output of the  
                  adder to a reference to form an error;

                  a conjugator arranged to conjugate the blocks of  
                  data;

                  a first data shifter arranged to shift the  
                  conjugated blocks of data left by two;

                  a second data shifter arranged to shift the  
                  conjugated blocks of data left by one;

                  a third data shifter arranged to shift the  
                  conjugated blocks of data right by one;

13                   a fourth data shifter arranged to shift the  
14                   conjugated blocks of data right by two;  
15                   a first correlator arranged to perform a  
16                   correlation of the error and the conjugated blocks of data  
17                   shifted by the first data shifter, wherein the first  
18                   correlator is arranged to control the first set of finite  
19                   filter coefficients;  
20                   a second correlator arranged to perform a  
21                   correlation of the error and the conjugated blocks of data  
22                   shifted by the second data shifter, wherein the second  
23                   correlator is arranged to control the second set of finite  
24                   filter coefficients;  
25                   a third correlator arranged to perform a  
26                   correlation of the error and the conjugated blocks of data,  
27                   wherein the third correlator is arranged to control the  
28                   third set of finite filter coefficients;  
29                   a fourth correlator arranged to perform a  
30                   correlation of the error and the conjugated blocks of data  
31                   shifted by the third data shifter, wherein the fourth  
32                   correlator is arranged to control the fourth set of finite  
33                   filter coefficients; and,

34                   a fifth correlator arranged to perform a  
35                   correlation of the error and the conjugated blocks of data  
36                   shifted by the fourth data shifter, wherein the fifth  
37                   correlator is arranged to control the fifth set of finite  
38                   filter coefficients.

1                   70. The equalizer of claim 69 wherein the  
2                   controller further comprises a down sampler upstream of each  
3                   of the first, second, third, fourth, and fifth correlators,  
4                   wherein the down samplers are arranged to down sample the  
5                   conjugated blocks of data.

1                   71. The equalizer of claim 69 wherein the  
2                   reference is a training signal.

1                   72. The equalizer of claim 69 wherein the  
2                   reference is sliced data.

1                   73. The equalizer of claim 65 wherein the  
2                   controller comprises:

3                   a comparator arranged to compare an output of the  
4                   adder to a reference to form an error;

5                   a first data shifter arranged to perform a shift  
6                   left by two based upon the blocks of data;  
7                   a second data shifter arranged to perform a shift  
8                   left by one based upon the blocks of data;  
9                   a third data shifter arranged to perform a shift  
10                  right by one based upon the blocks of data;  
11                  a fourth data shifter arranged to perform a shift  
12                  right by two based upon the blocks of data;  
13                  a first correlator arranged to perform a  
14                  correlation of an output of the first data shifter and the  
15                  error, wherein the first correlator is arranged to control  
16                  the first set of finite filter coefficients;  
17                  a second correlator arranged to perform a  
18                  correlation of an output of the second data shifter and the  
19                  error, wherein the second correlator is arranged to control  
20                  the second set of finite filter coefficients;  
21                  a third correlator arranged to perform a  
22                  correlation based upon the blocks of data and the error,  
23                  wherein the third correlator is arranged to control the  
24                  third set of finite filter coefficients;  
25                  a fourth correlator arranged to perform a  
26                  correlation of an output of the third data shifter and the

27 error, wherein the fourth correlator is arranged to control  
28 the fourth set of finite filter coefficients; and,  
29 a fifth correlator arranged to perform a  
30 correlation of an output of the fourth data shifter and the  
31 error, wherein the fifth correlator is arranged to control  
32 the fifth set of finite filter coefficients.

74. The equalizer of claim 73 wherein the reference is a training signal.

75. The equalizer of claim 73 wherein the reference is sliced data.

76. The equalizer of claim 65 wherein the controller comprises:

a conjugator arranged to conjugate the blocks of data:

a first data shifter arranged to shift the conjugated blocks of data left by two;

a second data shifter arranged to shift the conjugated blocks of data left by one:

9                   a third data shifter arranged to shift the  
10                  conjugated blocks of data right by one;  
11                   a fourth data shifter arranged to shift the  
12                  conjugated blocks of data right by two;  
13                   a first correlator arranged to perform a  
14                  correlation based upon an output of the adder and the  
15                  conjugated blocks of data shifted by the first data shifter,  
16                  wherein the first correlator is arranged to control the  
17                  first set of finite filter coefficients;  
18                   a second correlator arranged to perform a  
19                  correlation based upon the output of the adder and the  
20                  conjugated blocks of data shifted by the second data  
21                  shifter, wherein the second correlator is arranged to  
22                  control the second set of finite filter coefficients;  
23                   a third correlator arranged to perform a  
24                  correlation based upon the output of the adder and the  
25                  conjugated blocks of data, wherein the third correlator is  
26                  arranged to control the third set of finite filter  
27                  coefficients;  
28                   a fourth correlator arranged to perform a  
29                  correlation based upon the output of the adder and the  
30                  conjugated blocks of data shifted by the third data shifter,

31 wherein the fourth correlator is arranged to control the  
32 fourth set of finite filter coefficients; and,  
33                   a fifth correlator arranged to perform a  
34 correlation based upon the output of the adder and the  
35 conjugated blocks of data shifted by the fourth data  
36 shifter, wherein the fifth correlator is arranged to control  
37 the fifth set of finite filter coefficients.

0  
1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13

77. The equalizer of claim 65 wherein the controller comprises:

      a first data shifter arranged to perform a shift left by two operation based upon the blocks of data;

      a second data shifter arranged to perform a shift left by one operation based upon the blocks of data;

      a third data shifter arranged to perform a shift right by one operation based upon the blocks of data;

      a fourth data shifter arranged to perform a shift right by two operation based upon the blocks of data;

      a first correlator arranged to perform a correlation based upon an output of the adder and an output of the first data shifter, wherein the first correlator is

14 arranged to control the first set of finite filter  
15 coefficients;

16 a second correlator arranged to perform a  
17 correlation based upon the output of the adder and an output  
18 of the second data shifter, wherein the second correlator is  
19 arranged to control the second set of finite filter  
20 coefficients;

21 a third correlator arranged to perform a  
22 correlation based upon the output of the adder and the  
23 blocks of data, wherein the third correlator is arranged to  
24 control the third set of finite filter coefficients.

1                   78. The equalizer of claim 65 further comprising  
2                   a pre-processor that applies pre-processor coefficients to  
3                   each block of data upstream of the first, second, third, and  
4                   fourth data shifters and upstream of the third finite  
5                   filter, wherein the controller controls a width of the pre-  
6                   processing coefficients so that the width is substantially  
7                   coincident with the width of a block of data and an interval  
8                   between a block of data and a ghost.

802554230400  
1                   79. The equalizer of claim 78 wherein the  
2                   controller comprises a channel estimator that estimates the  
3                   channel through which the blocks of data are transmitted.

3                   80. The equalizer of claim 78 wherein the  
4                   controller controls the first, second, third, fourth, and  
5                   fifth sets of finite filter coefficients based upon an  
output of the adder.

1                   81. The equalizer of claim 78 wherein the  
2                   controller comprises a comparator that performs a comparison  
3                   based upon an output of the adder and the blocks of data.

1                   82. The equalizer of claim 78 wherein the  
2 controller comprises:

3                   a comparator arranged to compare an output of the  
4 adder to a reference to form an error;

5                   a conjugator arranged to conjugate the blocks of  
6 data;

7                   a first data shifter arranged to shift the  
8 conjugated blocks of data left by two;

9                   a second data shifter arranged to shift the  
10 conjugated blocks of data left by one;

11                  a third data shifter arranged to shift the  
12 conjugated blocks of data right by one;

13                  a fourth data shifter arranged to shift the  
14 conjugated blocks of data right by two;

15                  a first correlator arranged to perform a  
16 correlation of the error and the conjugated blocks of data  
17 shifted by the first data shifter, wherein the first  
18 correlator is arranged to control the first set of finite  
19 filter coefficients;

20                  a second correlator arranged to perform a  
21 correlation of the error and the conjugated blocks of data  
22 shifted by the second data shifter, wherein the second

23           correlator is arranged to control the second set of finite  
24        filter coefficients;

25                a third correlator arranged to perform a  
26        correlation of the error and the conjugated blocks of data,  
27        wherein the third correlator is arranged to control the  
28        third set of finite filter coefficients;

29                a fourth correlator arranged to perform a  
30        correlation of the error and the conjugated blocks of data  
31        shifted by the third data shifter, wherein the fourth  
32        correlator is arranged to control the fourth set of finite  
33        filter coefficients; and,

34                a fifth correlator arranged to perform a  
35        correlation of the error and the conjugated blocks of data  
36        shifted by the fourth data shifter, wherein the fifth  
37        correlator is arranged to control the fifth set of finite  
38        filter coefficients.

1               83. The equalizer of claim 82 wherein the  
2        controller further comprises a down sampler upstream of each  
3        of the first, second, third, fourth, and fifth correlators,  
4        wherein the down samplers are arranged to down sample the  
5        conjugated blocks of data prior.

1                   84. The equalizer of claim 82 wherein the  
2                   reference is a training signal.

1                   85. The equalizer of claim 82 wherein the  
2                   reference is sliced data.

1                   86. The equalizer of claim 78 wherein the  
2                   controller comprises:

                  a comparator arranged to compare an output of the  
                  adder to a reference to form an error;

                  a first data shifter arranged to perform a shift  
                  left by two based upon the blocks of data;

                  a second data shifter arranged to perform a shift  
                  left by one based upon the blocks of data;

9                   a third data shifter arranged to perform a shift  
10                  right by one based upon the blocks of data;

11                  a fourth data shifter arranged to perform a shift  
12                  right by two based upon the blocks of data;

13                  a first correlator arranged to perform a  
14                  correlation of the error and an output of the first data

15 shifter, wherein the first correlator is arranged to control  
16 the first set of finite filter coefficients;  
17                   a second correlator arranged to perform a  
18 correlation of the error and an output of the second data  
19 shifter, wherein the second correlator is arranged to  
20 control the second set of finite filter coefficients;  
21                   a third correlator arranged to perform a  
22 correlation based upon the error and the blocks of data,  
23                   wherein the third correlator is arranged to control the  
24                   third set of finite filter coefficients;  
25                   a fourth correlator arranged to perform a  
26 correlation of the error and an output of the third data  
27 shifter, wherein the fourth correlator is arranged to  
28 control the fourth set of finite filter coefficients; and,  
29                   a fifth correlator arranged to perform a  
30 correlation of the error and an output of the fourth data  
31 shifter, wherein the fifth correlator is arranged to control  
32 the fifth set of finite filter coefficients.

1                   87. The equalizer of claim 86 wherein the  
2 reference is a training signal.

1                   88. The equalizer of claim 86 wherein the  
2 reference is sliced data.

1                   89. The equalizer of claim 78 wherein the  
2 controller comprises:

3                   a conjugator arranged to conjugate the blocks of  
4 data;

5                   a first data shifter arranged to shift the  
conjugated blocks of data left by two;

6                   a second data shifter arranged to shift the  
conjugated blocks of data left by one;

7                   a third data shifter arranged to shift the  
conjugated blocks of data right by one;

8                   a fourth data shifter arranged to shift the  
conjugated blocks of data right by two;

9                   a first correlator arranged to perform a  
10 correlation based upon an output of the adder and the  
11 conjugated blocks of data shifted by the first data shifter,  
12 wherein the first correlator is arranged to control the  
13 first set of finite filter coefficients;

14                   a second correlator arranged to perform a  
15 correlation based upon the output of the adder and the

20                   conjugated blocks of data shifted by the second data  
21                   shifter, wherein the second correlator is arranged to  
22                   control the second set of finite filter coefficients;

23                   a third correlator arranged to perform a  
24                   correlation based upon the output of the adder and the  
25                   conjugated blocks of data, wherein the third correlator is  
26                   arranged to control the third set of finite filter  
27                   coefficients;

28                   a fourth correlator arranged to perform a  
29                   correlation based upon the output of the adder and the  
30                   conjugated blocks of data shifted by the third data shifter,  
31                   wherein the fourth correlator is arranged to control the  
32                   fourth set of finite filter coefficients; and,

33                   a fifth correlator arranged to perform a  
34                   correlation based upon the output of the adder and the  
35                   conjugated blocks of data shifted by the fourth data  
36                   shifter, wherein the fifth correlator is arranged to control  
37                   the fifth set of finite filter coefficients.

1                   90. The equalizer of claim 78 wherein the  
2 controller comprises:

3                   a first data shifter arranged to perform a shift  
4 left by two operation based upon the blocks of data;

5                   a second data shifter arranged to perform a shift  
6 left by one operation based upon the blocks of data;

7                   a third data shifter arranged to perform a shift  
8 right by one operation based upon the blocks of data;

9                   a fourth data shifter arranged to perform a shift  
10 right by two operation based upon the blocks of data;

11                   a first correlator arranged to perform a  
12 correlation based upon an output of the adder and an output  
13 of the first data shifter, wherein the first correlator is  
14 arranged to control the first set of finite filter  
15 coefficients;

16                   a second correlator arranged to perform a  
17 correlation based upon the output of the adder and an output  
18 of the second data shifter, wherein the second correlator is  
19 arranged to control the second set of finite filter  
20 coefficients;

21                   a third correlator arranged to perform a  
22 correlation based upon the output of the adder and the

23 blocks of data, wherein the third correlator is arranged to  
24 control the third set of finite filter coefficients;

25                   a fourth correlator arranged to perform a  
26 correlation based upon the output of the adder and an output  
27 of the third data shifter, wherein the fourth correlator is  
28 arranged to control the fourth set of finite filter  
29 coefficients; and,

30                   a fifth correlator arranged to perform a  
31 correlation based upon the output of the adder and an output  
32 of the fourth data shifter, wherein the fifth correlator is  
33 arranged to control the fifth set of finite filter  
34 coefficients.

91. The equalizer of claim 78 wherein the pre-processing coefficients are curved.

1                   92. The equalizer of claim 78 wherein the pre-  
2 processing coefficients are curved substantially according  
3 to a function  $1/(2 - \cos(t))$ .

